# Detecting Microcracking in Post-Tensioned Trunnion Rods

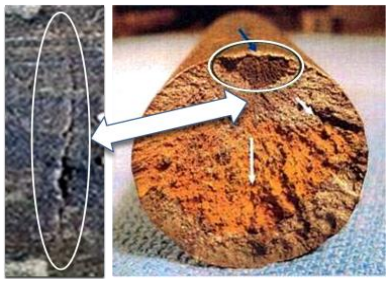
## Problem

Post Tensioned trunnion rods hold trunnion girders in place at many Corps of Engineers dams. The anchored ends near the gates are typically embedded in concrete, making the removal and replacement of the rods almost impossible. Special types of grease or grouts are injected into the ducts after tensioning to improve the corrosion resistance of the rods. This design has been standard practice since the 1940s. These trunnion anchor rods are now failing in various Corps navigational structures due to orthogonal cracks occurring randomly along their lengths. As these rods fail within a given group, increased demand is placed on the remaining rods. If enough rods within a group fail, the tainter gate will also fail. It is not currently known how many rods are in a cracked pre-failure state or if the current rate of rod failure is likely to increase in the future.

Trunnion rods ejected from pier

## Approach

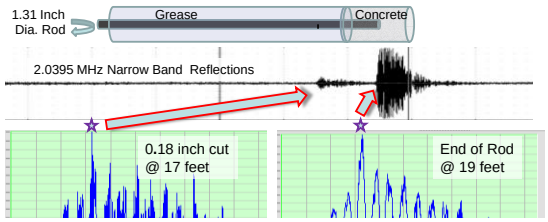
A method is needed to detect, quantify, and track the occurrence of trunnion anchor rod cracking. Presently, only tension can be assessed; this requires a lift off test, which is complex, dangerous, and expensive. In some cases the test itself has caused rods to fail. A non-destructive testing (NDT) method to test for early and late stages of cracks within the trunnion rods is needed. Current research indicates that nonlinear and conventional measurements acquired via ultrasonic guided waves will be effective in detecting microcracking down the length of the rod – distinguishing microcracking from rod contact with the proximal steel sleeve. This ultrasonic method, which has undergone preliminarily field testing, also presents new options for tracking tension changes and developing onsite monitoring.



Trunnion Rod Cross section with crack shown

## Products

This research will offer a quick and safe NDT system to test or monitor trunnion rods in-situ for early signs of failure, as well as define the technology for in-place monitoring. Guidelines for application across various diameters, end conditions, and embedment will be provided.




Test Bed Detection of Embedded Rod with Defects at 17 & 19 ft

## Benefits

This research is developing techniques, procedures and a specialized portable NDT system that will enable USACE personnel to ascertain and monitor the condition of trunnion rods in situ in the presence of grease- or grout-filled trunnion rod conduits. Catastrophic failure of post-tensioned trunnion anchor rods is an ongoing problem caused by propagating orthogonal cracks within trunnion rods which has been described in Technical Note CHETN-IX-32. In addition that document provides background information and initial test bed investigations of nonlinear and guided wave methods directed at the development of a non-destructive testing capability for long distance microcrack detection in embedded rods.

**POC:** Jim Evans James.A.Evans@usace.army.mil
Charles E. “Eddie” Wiggins Charles.E.Wiggins@usace.army.mil